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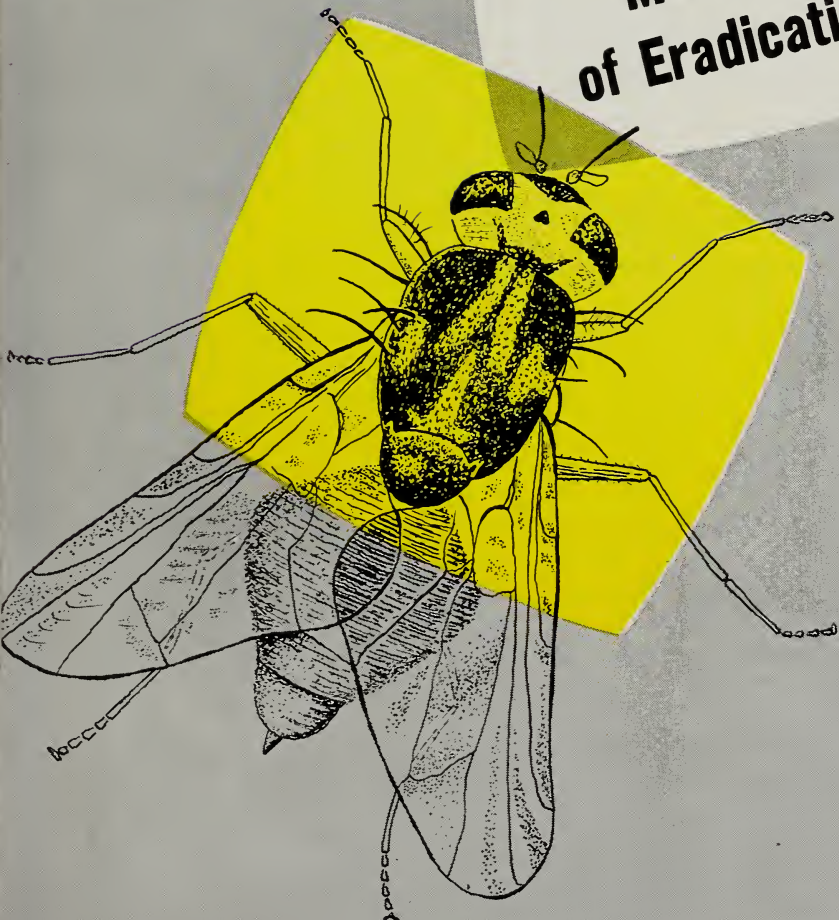
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The Mediterranean Fruit Fly

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Methods
of Eradication



PA No. 301
UNITED STATES DEPARTMENT OF AGRICULTURE

The Mediterranean Fruit Fly



The Mediterranean fruit fly¹ is one of the world's most destructive fruit pests. It attacks citrus fruits and more than 200 other fruit and vegetable crops. In some countries this insect has made commercial fruit production difficult or impossible.

Only twice has this pest gained a foothold in continental United States—in 1929 and in 1956.

The 1929 infestation, which involved 20 counties in central Florida, was eradicated by late 1930 at a cost of \$7½ million—a small fraction of what the cost to growers would have been had the pest become permanently established.

The 1956 infestation, which was

discovered in April in greater Miami, Fla., and nearby areas, is now the object of all-out Federal-State regulatory and control efforts. These efforts are aimed at preventing the spread of the insect to uninfested areas and at eradicating the present infestation as quickly as possible.

Only a coordinated program carried out by organized groups—Federal, State, and local—can stamp out the Mediterranean fruit fly. The effectiveness of such a program depends on the full cooperation of individuals, particularly growers, homeowners, shippers, processors, and tourists in or near the infested area.

ORIGIN AND SPREAD

A notorious world traveler, the Mediterranean fruit fly is established today in many countries thousands of miles away from its native Africa.

It has been in the Mediterranean area since about 1863; in Bermuda since 1890; in Australia since 1897; in South America since 1901; and in Hawaii since 1910. In 1955 an extensive infestation was discovered in Costa Rica.

The insect is spread from country to country chiefly in infested fruits carried by tourists or shipped commercially. Once the pest is established in a locality it can spread quickly by natural flight, by wind

drift, and by transportation of infested fruit, vegetables, or soil. In addition, the fly may hitchhike out of the infested area in automobiles, trucks, airplanes, boats, and other vehicles.

Federal plant-quarantine inspectors have prevented the earlier establishment of the Mediterranean fruit fly in the United States by intercepting it at least 1,800 times at dozens of places along our borders. They have found and destroyed it in fruit or plants in passengers' baggage or in commercial shipments of host products (products that may harbor the insect in one or more of its forms).

DAMAGE

Nature of Damage

The female fly punctures the fruit and deposits eggs just beneath the skin. The eggs hatch into larvae, which burrow into the fruit, feed, and develop. The fruit spoils

and usually falls to the ground.

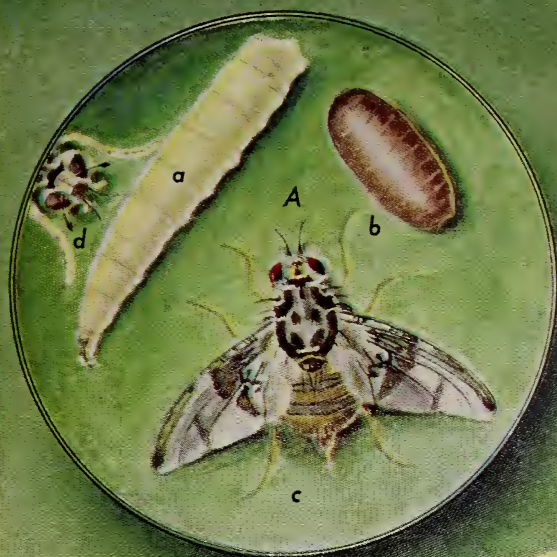
There may also be loss of fruit from rots that develop about the fly stings, even when the fly lays no eggs.

¹ *Ceratitidis capitata* Weid.

MEDITERRANEAN FRUIT FLY

A, Life stages: a, larva;
b, pupa; c, adult fe-
male; d, head of male.
(All greatly enlarged.)

B, Infested grapefruit with
advanced internal and
external damage. Lar-
vae about natural size.



Brushman 1956

Crops Attacked

The fly may attack any one of more than 200 fruits and vegetables, but it does have a preference for a few.

Citrus fruits, except lemons and sour limes, are among the preferred hosts. Lemons appear to be practically immune from attack, and, ordinarily, only overripe sour limes become infested.

Other preferred hosts among this country's major fruit crops are peaches, pears, plums, and apples.

In the infested area centering around Miami the most susceptible hosts of the Mediterranean fruit fly are calamondin, Surinam cherry, peaches, and mango. Other preferred hosts in that area are papaya, guava, loquat, rose apple, and tropical almond.

Extent of Damage

The exact amount of damage done by this pest each year over the world has never been determined. However, some idea of the cost of letting the Mediterranean fruit fly become established in a fruit-growing country or area can be gained from the following estimates of losses.

- In Greece, up to half of the citrus crop has been lost in some years; damage to summer fruits is even greater.
- In Sardinia in 1950, at least 80 percent of the peach crop was lost, and apple, pear, and

avocados may be lightly attacked; however, infestations in mature, hard, green avocados (such as those picked for the commercial trade) are seldom serious enough to cause much loss. Some Guatemalan types of avocados appear to be highly resistant to the fly; avocados of the West Indian race occasionally are moderately infested.

The smooth Cayenne variety of pineapple is seldom damaged by this insect, but some other varieties of pineapple are more subject to infestation.

Green peppers become lightly infested. Infestations of economic importance seldom develop in cantaloup or in tomatoes, eggplant, cucumbers, and other vegetables.

orange crops were seriously damaged.

- In some areas of Africa and South America the pest has made commercial fruit production difficult or impossible. In North Africa, in coastal and irrigated areas of high humidity, the insect is particularly damaging to peaches, pears, and apricots. In Brazil, oranges and other fruits are frequently attacked, as well as coffee and many other cultivated and wild plants.

DEVELOPMENT AND APPEARANCE

The Mediterranean fruit fly probably can produce about 10 generations a year in Florida. It has four life stages—adult (fly), egg, larva (maggot), and pupa.

The *adult* is a little smaller than a housefly. Its body is yellow, tinged with brown. The upper part of the section of the body that bears the legs is marbled with shiny black splotches. The abdo-

men is oval; it has two fairly broad silvery bands. The wings usually are extended and slightly drooping; they are colorless except for brown or black markings.

NOTE.—Life stages of the Mediterranean fruit fly are illustrated on page 3. The illustration is in color because the characteristics that distinguish this fly from a number of other fruit flies cannot be adequately shown in black and white.

The adults usually live 30 to 60 days. They are strong fliers.

The female adult pierces the skin of a host fruit with the needle-like ovipositor (or egg-laying apparatus) at the end of her abdomen. She then deposits 1 to 10 eggs in this puncture. This same egg puncture may be used by other Mediterranean fruit flies; several hundred eggs have been found in a single cavity. When conditions are favorable, female flies probably lay an average of about 300 eggs during a lifetime.

The tiny, elongate, glistening eggs are barely visible. They hatch into larvae in 2 to 4 days.

The larva is a slender, cream-colored maggot. It completes its

development in 7 to 11 days. When the larva is mature it leaves the fruit and enters the soil. It may drop to the ground from the fruit on the trees; usually, however, the fruit has dropped to the ground by the time the larva is mature.

Larvae can travel short distances. They curl the middle part of their bodies upward and jump 4 to 5 inches from this looped position.

In the soil the larva changes into a pupa.

The pupa changes into a fly in 8 to 14 days, after which the fly emerges from the soil.

The flies become sexually mature in about 7 to 9 days. They mate, the female lays eggs, and the life cycle has begun again.

FEDERAL-STATE ERADICATION PROGRAM

Eradiation of the Mediterranean fruit fly from the continental United States is the objective of the cur-

rent Federal-State program. Three phases of this program are surveys, quarantines, and control operations.

Surveys

As soon as the Mediterranean fruit fly was found in Florida, a detection survey was begun to locate and delimit infested areas.

Fruit-fly traps, set up at strategic points, were baited with oil of angelica seed, which had been discovered to be a powerful fruit-fly attractant only a month before.

This attractant is considerably more alluring to male flies than those used previously.

Spot infestations located by the surveys are sprayed within hours after they are discovered.

Fruit-fly traps are also used to check on the effectiveness of control measures in the infested area.



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To prevent spread of the Mediterranean fruit fly in infested material carried by tourists, inspection stations are set up on highways leading out of the regulated area. Each automobile operator is asked to declare his baggage, and inspectors make a routine search of the baggage compartment. All host materials found are confiscated, then destroyed.

Quarantines

Federal and State quarantine regulations to prevent the spread of the Mediterranean fruit fly to uninfested areas were put into effect promptly after the discovery of the 1956 infestation.

Federal quarantine regulates movement from Florida to other States of any articles that may harbor the insect. State regulations control movement of these articles to uninfested parts of the State.

Regulated articles consist principally of—

- Fruits, vegetables, and other garden and orchard products.
- Sand, soil, earth, peat, compost, and manure.
- Fruit-picking equipment.
- Trucks, wagons, cars, aircraft, boats, and other means of conveyance, and containers used in conveying fruits or vegetables.
- Other products and articles that have been associated with the production of or commerce in fruits and vegetables or that have been or are contami-

nated with sand, soil, earth, peat, compost, or manure.

Federal inspectors issue certificates for the transportation of regulated articles under one or more of the following conditions:

- The articles have not, in the judgment of an inspector, been exposed to infestation.
- They have been examined by an inspector and found to be free from infestation.
- They have been treated under the observation of an inspector according to approved methods that make the articles safe to transport into uninfested areas.

Citrus fruit, for example, may be made safe to transport by fumigation with ethylene dibromide. This treatment is faster and less expensive than either of the two treatments—vapor-heat process and cold storage—used in the 1929–30 eradication campaign.

Control Operations

Bait spray

A recently perfected bait spray, which is applied to vegetation by airplanes and ground sprayers, is one of the main weapons being used in the fight against the adult insect. Properly applied, this spray is not harmful to human beings.

The spray contains both a poison (malathion 25-percent wettable powder) and a bait (enzymatic protein hydrolysate or sauce base). The bait contains certain essential fruit-fly nutrients that make it attractive to the flies. Deposits of this spray usually attract twice as many females as males.

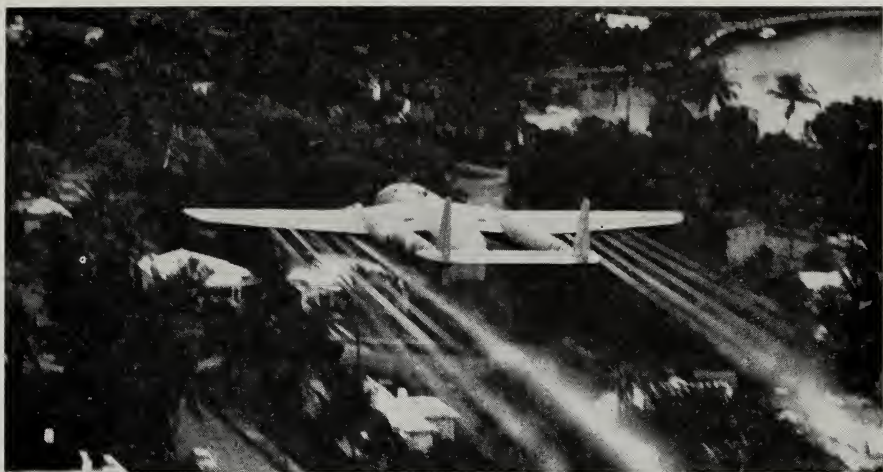
Because flies seek out the poison bait, complete coverage of each tree or plant is not necessary for effective application of the spray. Also, less poison is required to make

this spray than is needed in contact sprays that must hit each insect to be effective.

To make spray enough for 1 acre, 1 pound of protein hydrolysate or 1 quart of sauce base and 2 to 3 pounds of malathion 25-percent wettable powder are mixed with 1 gallon or more of water.

The bait spray is applied uniformly over all of an area. It is applied as a coarse spray; a drenching spray is not necessary. Spray deposits on foliage are more attractive to the flies than deposits on the trunks, limbs, or fruit of the trees.

The bait spray is applied at intervals of 10 to 14 days. The length of time allowed between sprayings depends on the frequency and intensity of rain and on other climatic conditions.



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Airplanes and ground sprayers are used to apply malathion-bait spray to vegetation in infested areas. This spray is one of the main weapons being used in the fight against the adult Mediterranean fruit fly.

Soil treatment

Insecticides applied to the soil will kill some larvae as they enter the soil to pupate and most of the adults as they emerge from the soil.

In the infested area in Florida, granulated dieldrin or granulated heptachlor is being applied as a supplement to other control measures.

HOW YOU CAN HELP

The campaign to eradicate the Mediterranean fruit fly is of vital importance to agriculture in the United States. Control officials are

aware of the seriousness of the problem. They are prepared for a lot of hard work. Your cooperation and patience are needed.

Here Are the Important Ways You Can Cooperate:

1. If you see a fly or larva resembling those pictured in this publication, report this fact to your local State Plant Board official or county agent. (Such action by an alert homeowner in North Miami led to the discovery of the present infestation.)
2. Give control workers free access to your property for applying insecticides, operating traps, and inspecting fruits.
3. Cooperate with quarantine officials: Do not try to take any fruit, vegetables, soil, or other articles that may harbor the pest out of the infested area unless you can comply with quarantine regulations. (See p. 6.)
4. When area-wide sprays are applied in your locality, follow the suggestions of the control officials concerning ways you can cooperate. You will read or hear these suggestions in your newspapers, on radio, and on TV.

*This publication was prepared by
the Plant Pest Control Branch and
the Entomology Research Branch,
Agricultural Research Service.*

Washington, D. C.

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**Effective granular insecticides being
applied under host trees to kill larvae
as they enter the soil and flies as
they emerge.**